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Fundamentals of Auditory Impairment for the Speech-Language Pathologist

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Fundamentals of Auditory Impairment for the Speech-Language Pathologist

by

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Report

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Dedication

This report is dedicated to all my family, friends, and loved ones who have supported me throughout graduate school and working towards my master's degree in speech-language pathology. I would also like to dedicate this report to all my clients and patients whom I have learned so much from and have affirmed my passion for working in this field.

Acknowledgements

I would like to thank my advisor and mentor Dr. Madhu Sundarrajan for all her support and guidance throughout the past year on this research project. I would also like to thank my co-advisor Dr. Julia Campbell for her patience and support of this report as well. Additionally, I would like to acknowledge the University of Texas at Austin Speech and Hearing Center and specifically my former auditory impaired client, whom inspired me to write this report and continue research in the area of auditory impairment as a speech-language pathologist.

Abstract

Fundamentals of Auditory Impairment for the Speech-Language Pathologist

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The purpose of this guide is to outline the fundamentals of speech, language, and hearing that are needed for speech-language pathologists (SLPs) to work with children with auditory impairment (AI). Specifically, SLPs must understand the basics of audiology and aural rehabilitation when working with the auditory impaired population and the impact hearing problems have on speech and language. A primary goal of this report is to describe and critically examine principles of evidence-based practice and treatment approaches specifically designed for and/or commonly used with AI patients. This report breaks down some of the most essential information an SLP may need when working with children with AI, specifically sensorineural hearing loss (SNHL), including but not limited to the following: causes and types of auditory impairment, understanding an audiogram, types of amplification systems, communication options, and treatment methods.

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CHAPTER 1: INTRODUCTION TO AUDITORY IMPAIRMENT

AI is an impairment in hearing, whether fluctuating or permanent, that is so significant it negatively affects a child's educational performance or ability to learn (Individuals with Disabilities Education Act (IDEA), 2004). It is estimated that about 28.6 million Americans have an AI with as many as 738,000 individuals with severe to profound HL. Of these, about 8% are children under the age of 18 (Blanchfield, 2001). With children, it is important to diagnose and treat AI as early as possible, as AI can detrimentally impact learning and development. Specifically, hearing is critical to speech and language development. Many children with AI may have difficulty learning vocabulary, grammar, syntax, and other forms of communication (National Information Center, 2004). Typically, pediatricians and pediatric audiologists are among the first professionals to work with a child with AI and their family after identification. However, many of these children transition to working with SLPs who promote early and consistent communication intervention as a way of preventing or minimizing speech and/or language deficits. Both audiologists and SLPs work to prevent, diagnose, and treat communication disorders in many different populations and settings. Although both professions do not always directly interact with one another, substantial knowledge and skills are applicable to each discipline. Thus, it is essential for all SLPs to be knowledgeable in assessing and treating children in this diverse population.

Causes of AI

AI can be caused by one or a combination of factors including genetic causes, environmental influences, aging, illness, ototoxic drugs, central dysfunction, or head injury (ASHA, 2015)

Congenital Hearing Loss

Congenital hearing loss (HL) refers to HL present at birth, caused by either genetic or non-genetic factors.

Non-genetic factors account for about 25% of congenital HL (ASHA, 2015). Some examples include:

- Maternal infections (e.g. herpes)
- Prematurity
- Low birth weight
- Ototoxic medications (Roizen, 2003)
- Anoxia
- Birth injuries

Genetic Factors account for more than 50% of all AI. Genetic defects can be present at birth or develop later in life (ASHA, 2015).

- **Autosomal recessive HL** accounts for 70% of genetic AI. Both parents carry a recessive gene which is passed along to the child. Many parents are unaware they are carrying this defective gene and are surprised to learn their child has an AI (ASHA, 2015).
- **Autosomal dominant HL** accounts for about 15% of all genetic AI. One parent carrying the dominant gene passes it along to their child (ASHA, 2015).

Genetic syndromes often include HL as one of the symptoms, including but not limited to some of the following examples (ASHA, 2015):

- Down syndrome
- Usher syndrome
- Treacher-Collins syndrome
- Crouzon syndrome
- Alport syndrome
- CHARGE syndrome

Acquired Hearing Loss

Acquired HL appears after birth, typically resulting from an illness or injury and can occur at any time in life. Some examples of acquired HL include (ASHA, 2015, Tye-Murray, 2015):

- Ear infections
- Meningitis
- Chicken pox
- Flu
- Head injury
- Noise exposure

Types of Hearing Loss
There are four main types, or categories, of hearing loss. These include:

Conductive HL (CHL)	Sensorineural HL (SNHL)	Mixed HL (MHL)	Retrocochlear/Central HL (RHL)
• Ear infection (otitis media) • Poor Eustachian tube function • Perforated eardrum • Foreign body • Impacted cerumen	• Illness/ Ototoxic drugs • Genetic • Aging • Head trauma • Loud noise exposure	• Illness/Ototoxic drugs • Genetic causes • Head trauma • Impacted cerumen • Perforated tympanic membrane	• Infections • Vascular disorders • Aging • Tumors • Auditory neuropathy • Ototoxic medications

Severity of HL

- **CHL:** if air conduction thresholds show a HL but bone conduction thresholds are normal (Meier, 2007).
- **SNHL:** if both air and bone conduction thresholds are the same amount of HL (Meier, 2007).
- **MHL:** when bone conduction thresholds show a HL and air conduction shows a greater HL (Meier, 2007).

Table 1. Degrees of HL (WHO, 2017)

Degree	Range (db HL)
Slight/mild	26 to 40
Moderate	41 to 60
Severe	61 to 80
Profound	81 +

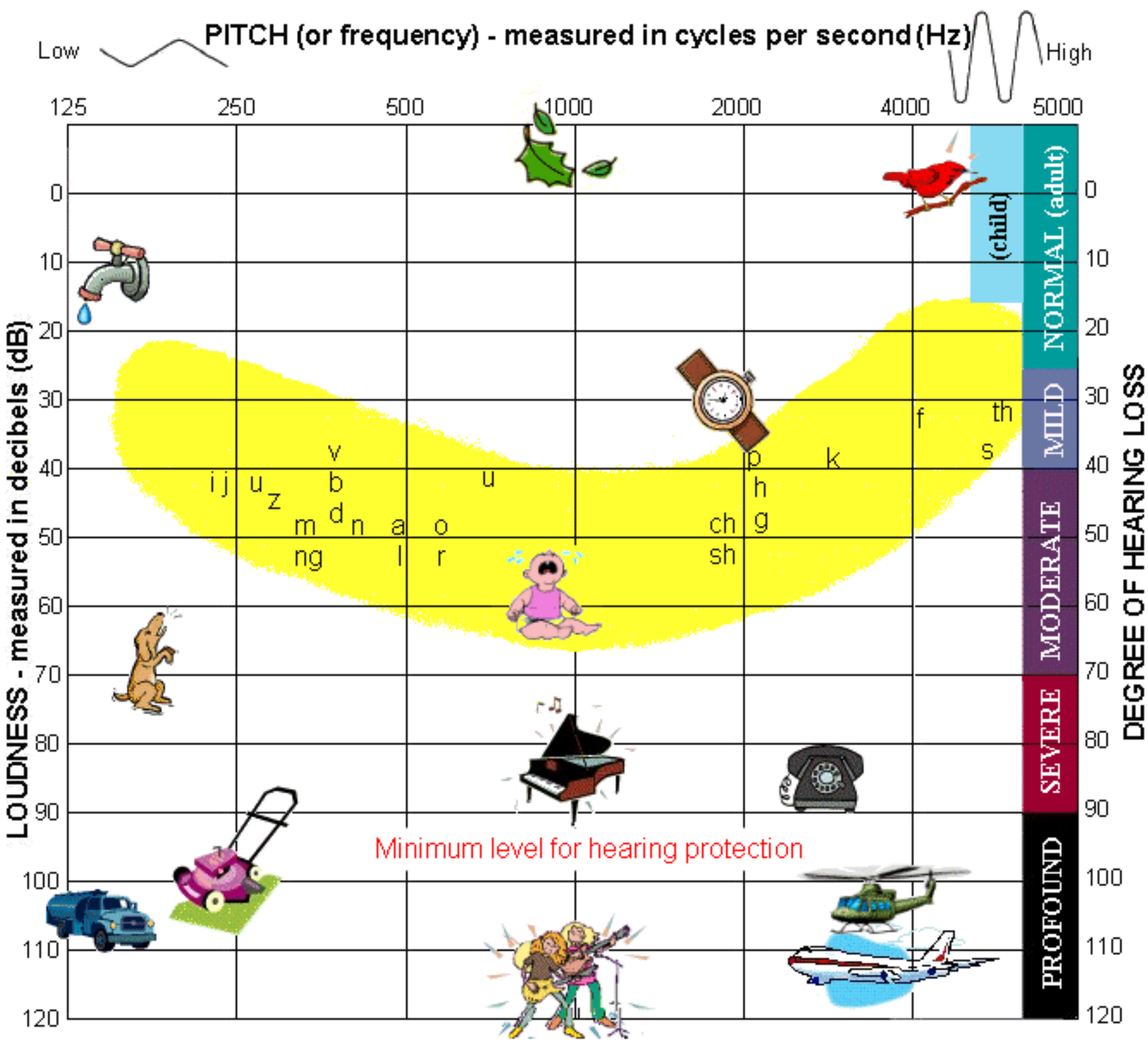
Table 2. Effects of HL on Speech Recognition (Flexer, 1999)

DEGREE	EFFECT ON WORD RECOGNITION
Mild	In noisy environments, speech recognition may decrease to 50% of words. If HL involves loss of high frequency sounds, some consonants will be difficult to hear.
Mild-to-moderate	Patient can understand most speech in a quiet environment speaking face-to-face with a conversation partner. If not using a hearing aid, patient may lose 50-75% of spoken message if pure tone average (PTA) is greater than 50 dB HL.
Moderate	If not using amplification, patient will not understand most of the message, even when talking face-to-face. Patient will also have great difficulty in group conversation environments.
Severe	Patient has difficult hearing voices unless spoken loudly. With amplification, patient may recognize some speech and environmental sounds.
Profound	Patient will use vision and maybe speech reading as mode of speech recognition. Patient will perceive sounds as vibration and may not even hear loud sounds without amplification.

The Speech Banana

The ‘speech banana’ represents intensity and frequency of phonemes on an audiogram depicted in the shape of a banana. The sounds within the speech banana are sounds most typical for speech within normal limits. Children who are unable to hear sounds within this shaded area may have trouble with some aspects of speech and language.

Figure 1. Speech Banana



*S*ource: https://www.agbell.org/professionals/auditory-functioning/the-speech-banana/

Understanding an Audiogram

An **audiogram** depicts the range of sounds a human can hear in each ear. During hearing testing, the most commonly used frequencies include **250, 500, 1000, 2000, 4000**, and **8000** Hz (John Hopkins, 2016), located at the top of the audiogram along the x-axis.

- Sound intensity or loudness lies on the vertical axis and is measured in decibels (dB).
- -10 or 0 dB indicates extremely soft sounds, while 110 dB indicates extremely loud sounds.
- 0 dB means that this is the softest level a person can perceive sound at least 50% of the time, ***not** that there is no sound*.
- Normal conversational speech is around 45 dB (Meier, 2007).

Air conduction is testing done with headphones, as the sound travels through the air of the ear canal. The red circles 'O' or a triangle graphed on an audiogram represents the **right ear** and the blue 'X' or square indicate the left ear using air conduction (e.g. headphones). Any points that are heard at 20 dB or softer are considered to be within normal range (Meier, 2007).

Bone conduction is depicted with the < or [symbol in the **right ear** and > or] in the **left ear**. The bone-conduction vibrator is a device that rests on the mastoid process of the skull behind the ear. The vibrations are directed to the cochlea as they bypass the outside and middle ear (Meier, 2007).

Table 3: Audiogram Legend/Key

	Right Ear	Left Ear
Air Conduction (AC)	○	X
AC with Masking	△	□
Bone Conduction (BC)	<	>
BC with masking	[	]
No Response	↙	↘

For more information on Audiograms:

https://www.utdallas.edu/~thib/rehabinfo/tohl.htm

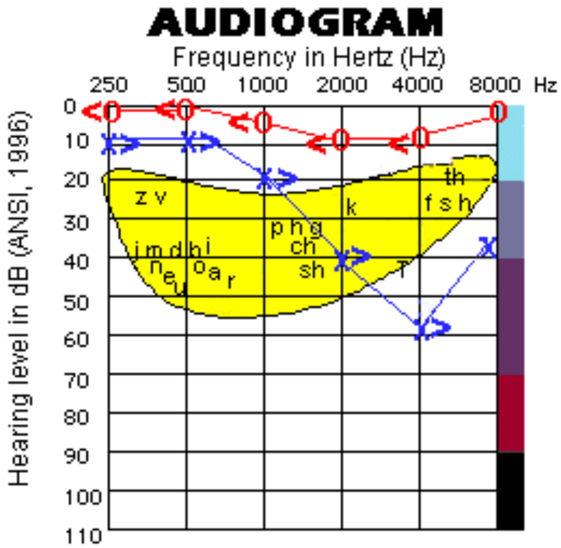
http://www.firstyears.org/lib/howtoread.htm

http://www.hearingloss.org/sites/default/files/docs/HLM_SeptOct2014_LarryMedwetsky_Audiogram2.pdf

http://www.chimehealth.co.uk/web/data/audiogram-hearing-loss-examples-2.pdf

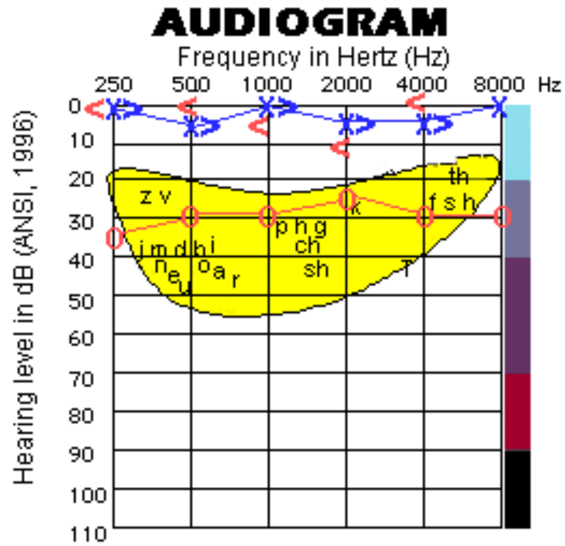
Audiograms

Figure 2. Audiograms



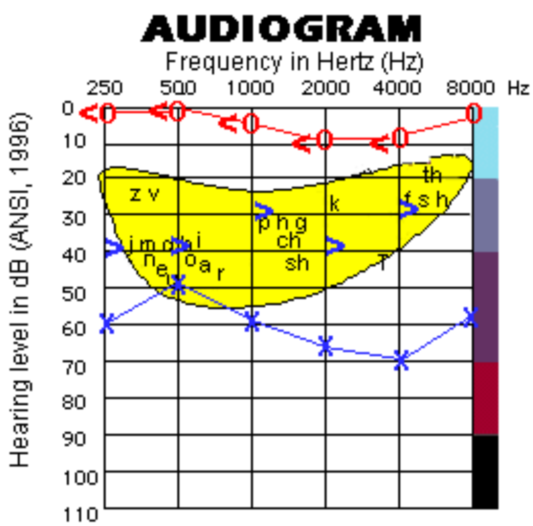
Right Ear: Normal

Left Ear: SNHL



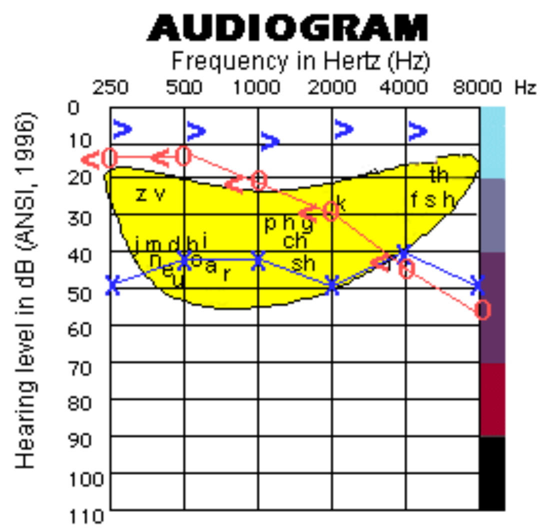
Right Ear: CHL

Left Ear: Normal



Right Ear: Normal

Left Ear: MHL



Right Ear: SNHL

Left Ear: CHL

Amplification

Annually, 3 in 1,000 infants are born in the U.S. with moderate, severe, or profound AI resulting in delayed speech, language, and learning development. A newborn hearing screening is implemented during the first few weeks of life in order to identify AI or require further evaluation and identify any medical conditions that can cause late-onset AI (ASHA, 2013). According to the American Academy of Pediatrics (AAP) Early Detection and Intervention, the follow guidelines have been created to ensure each child with AI is diagnosed and receives appropriate and timely intervention.

Early Hearing Detection and Intervention 1-3-6 Model

- Hearing screening by 1 month
- Diagnosis of AI by 3 months
- Entry into early intervention (EI) by 6 months

Hearing Aids Over the Years

Prior to the 20th century, communication partners were asked to speak loudly or talk face-to-face AI individuals (Tye-Murray, 2015). In 1955, hearing aids (HAs) were introduced as the first electronic device able to be worn in the ear (Tye-Murray, 2015). HAs transformed the ability to assist the AI population, beginning with analog aids and then digital HAs toward the end of the 20th century. Modern HAs are now lighter, smaller, easier to wear and designed to enhance signal processing.

- **Analog HAs** amplify speech and noise by making continues sound waves louder—converts acoustic to electrical wave.
- **Digital HAs** transduce sound waves into a digital signal, apply signal processing algorithms to alter sound according to the patient's HL, and transduce the digital signal back to an acoustic signal for the patient to hear (allow for more complex sound processing during amplification).

Hearing Aid Components

Microphone: picks up the acoustic signal from the environment and converts it into an electrical signal. Modern HAs can alternate between directional and omni-directional microphones (Tye-Murray, 2015).

- **Directional:** sensitive to the source(s) of sound around the listener. This system considers the spatial differences between the relevant signal and noise ("Hearing Aids," 2016).
- **Omnidirectional:** responds to sounds coming from all directions (Tye-Murray, 2015).

Amplifier: the electrical signal is processed and sound intensity increases.

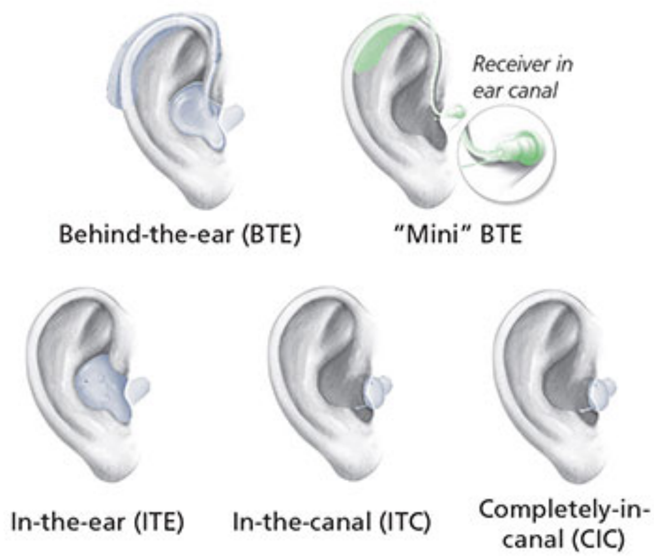
Receiver: the electrical signal is converted back into acoustic energy and to the ear through the speaker.

Types of Hearing Aids

Behind-the-ear (BTE) HAs are worn over the pinna and consist of a hard plastic case connected to an ear mold that fits inside the outer ear. Sound travels from the HA through the ear mold and into the ear. This type of aid is the most flexible style of HA as it can be fitted with various options ("Hearing Aids," 2016).

- Use: mild to profound HL
- Advantages: greater safety than other types of aids, able to be hardwired to an assistive listening device (ALD), limited feedback problems, easy to clean
- Disadvantages: may be noticeable, not aesthetically pleasing, may pick up noise from the wind

Figure 3. Types of HAs



Credit: Photo courtesy of the National Institutes of Health, Department of Health and Human Services. https://www.nidcd.nih.gov/health/hearing-aids

In-the-ear (ITE) HAs fit completely inside the concha

- Use: mild to severe HL
- Advantages: some ITEs have an installed telecoil, a small coil that allows sound to be received through the circuitry of the HA rather than the microphone, often used when talking on the phone.
- Disadvantages: prone to problems with moisture and ear wax, require daily cleaning, feedback problems

In-the-canal (ITC) HAs are almost completely the same as ITEs, but fill less space of the concha

- Use: mild to moderately severe HL
- Advantages: smaller, not as noticeable, do well in noise
- Disadvantages: not best for patients who can hear the lower frequency, as they magnify an occlusion effect.

Completely-in-canal (CIC) HAs completely in the ear canal

- Use: mild to moderately severe HL
- Advantages: reduction of feedback, improved sound localization, enhanced telephone use without need for ALD, and greater high-frequency gain (Tye-Murray, 2015)
- Disadvantages: very small and may be difficult for a patient to adjust and remove. They do not have an on-off switch, volume control or a telecoil. CICs are also high-maintenance device as cerumen builds up, requiring frequent cleaning.

LIMITATIONS OF HAS

Although technology has improved over the years, there are still drawbacks to using HAs. For example, a HA can be potentially uncomfortable, sometimes sound unnatural, especially when first fitted, and background noise may be loud and distracting. In fact, it can take several weeks or months to adjust to listening with the new device. HAs also do not improve hearing over time and cannot "cure" AI. Finally, HAs can be expensive and might not always be financially feasible for the user to purchase, maintain over time, or be the most appropriate intervention tool.

For more information on Hearing Aids:
http://www.asha.org/uploadedFiles/AIS-Learning-Hearing-Aids.pdf
https://www.embracehearing.com/pages/how-do-hearing-aids-work

Hearing Aid Tutorial

Speech-language pathologists must know the basics of HAs when working with AI patients. Properly functioning HAs will positively affect speech and language outcomes in and outside of therapy. HAs require daily care to ensure they work properly ("Audiology Information Series Hearing Aids," n.d.).

Clean regularly. Clean HAs with a soft, dry cloth and check for dirt. Ear molds can be removed to clean, but must remain dry before attaching them to the hearing aids again.

Check Batteries. Batteries last around 3-22 days and should be checked regularly with a battery tester. Length of time depends on HA type, severity of loss, and signal processing strategies. Batteries should be stored in a cool, dry place.

Listening Checks. Listen to the HA every day for strong, clear sounds and note if it is weak or scratchy.

Avoid feedback. Feedback occurs when amplified sounds come out of the ear mold and re-enter the microphone. Feedback may suggest that the ear mold is too small or there is cerumen in the ear canal.

What to do if the Hearing Aid is not functioning properly?

No sound

- Make sure hearing aid is turned on and loud enough to hear
- Check battery and receiver
- Check if tubing is connected properly and it is not bent or twisted
- Check for cerumen occlusion

Distorted or intermittent

- Moisture may be present in tubing and should be removed with an air blower.
- Check for cracks or holes in the tubing
- Battery may be weak or defective

Feedback

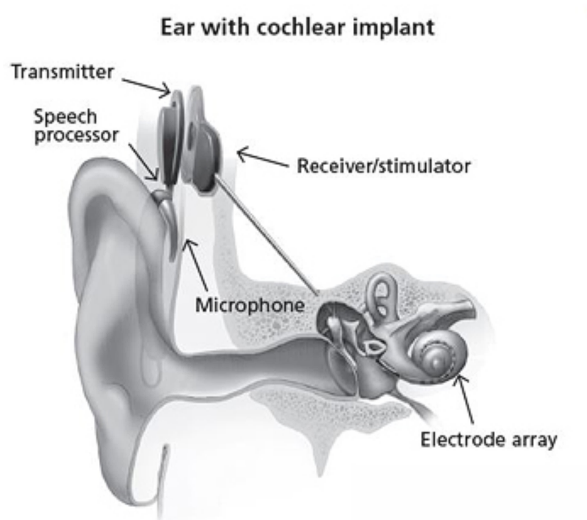
- Make sure volume is not too high or covered by an object (e.g. hat, scarf)
- Check for excessive cerumen buildup
- Make sure ear mold is placed comfortably in the ear
- As child grows, ear molds may become too small, resulting in feedback—need new ear mold

Battery Basics

- Remove tab on battery before inserting it into hearing aid
- Insert battery with positive (+) sign up
- Opening the battery door when not in use will extend battery life

Cochlear Implants

Figure 4. Implanted CI



Credit: Photo courtesy of the National Institutes of Health, Department of Health and Human Services. https://www.nidcd.nih.gov/health/cochlear-implants

A **cochlear implant (CI)** is an electronic device consisting of an electrode array surgically implanted into the inner ear to restore auditory function. CIs bypass damaged hair cells of the cochlea to provide sound signals to the brain (NIH, 2007). Profound AI children may benefit from CIs, especially when HAs are not beneficial.

IMPACT OF CI

Depending on age, AI identification, family support and other critical factors, some children who receive implants earlier in life, along with rehabilitation, may achieve speech and language skills exceeding their profoundly HL age-related peers with HAs.

- The optimal age for a CI is prior to age five in order to achieve the best speech and language outcomes over time (Chandra, Kumar, & Roy, 2016)
- Sensitive period for implantation <3.5 years (Sharma & Campbell, 2011)
- New data indicates even younger implantation (<1 year) results in better outcomes (National Institute on Deafness & Communication Disorders, 2016.)
- During word-learning tasks, both receptive and expressive language skills develop better when parents follow the child's lead rather than directing the child to a specific object and labeling it (Kaiser & Hancock, 2003).
- The use of oral language may have better speech and language outcomes than children in total communication environments after CI implantation (Holt et al., 2012).

LIMITATIONS OF CIS

Not only can CIs be very expensive, but general risks from surgical implantation may also be a concern. Surgical risks may include infection, blood or fluid collection at the site of surgery, tinnitus, and numbness around the ear. Other limitations associated with use of CIs may be hearing sounds as "artificial, mechanical, or synthetic," loss of residual hearing, no guarantee a child will understand language well, depending on batteries for hearing, and possible failure of CI (U.S. Food and Drug Administration, 2014). Overall, many factors play a role in candidacy and success of speech and language outcomes for a child with CI, and both SLPs and caregivers should be aware of these limitations.

SPEECH AND LANGUAGE SKILLS

Children born with AI may experience both speech and language delays.

- Individuals with CIs have limited access to auditory input prior to their CI, often experiencing a delay in exposure to spoken language.
- Auditory input from a CI is an electrical signal not identical to natural hearing.

AI VERSUS NORMAL HEARING

Children with AI demonstrate a slower rate of grammatical development and weakness of morpheme acquisition (e.g. unstressed syllables shorter in duration); this can result in deficits of production of high-frequency consonants (i.e. /s/, /z/, and /t/) that are difficult to hear in conversation (Chandra et al., 2016). CI children also demonstrate reduced abilities in producing elaborated phrases and sentences as compared to normal hearing children, especially in complex sentences. CI users may also have deficits in syntactic areas relative to vocabulary (Chandra et al., 2016). However, children with CIs or HAs prior to 8 months appear to understand similar syntactic abilities as compared to hearing children (Chandra et al., 2016).

Common Speech & Language Errors May Include errors in (Archer & Crosby-Quinatoa, n.d.):

- Verbs and adjectives
- Gender markers
- Singular/plural forms
- Complex phrases and sentences.

BILINGUAL CHILDREN

Bilingualism specifically defined within this population may include speaking any two languages (oral, manual, or mixed), as well as using ASL with any oral spoken language. Providing therapy in two languages may lead to better speech and language outcomes than providing monolingual therapy (Bunta et al., 2016). In fact, children who are provided dual-language support have been found to outperform their peers with English-only supports on expressive and overall total language skills (Bunta et al., 2016).

Languages spoken primarily used by a child with AI depend on several factors (Gravel and O'Gara, 2003). Caregivers may make decisions for their child according to their age, environment, and socioeconomic status. Other significant factors may include country of birth of caregivers, level of education, cultural identity, and communication preference (Okita, 2002; Schwartz et al., 2010). Unfortunately, there is very little research examining bilingual children with AI, thus it is difficult to determine the most influential factors that affect diagnosing and treating a bilingual child with AI.

For more information on Cochlear Implants:
http://www.asha.org/uploadedFiles/AIS-Cochlear-Implants.pdf // https://www.nidcd.nih.gov/health/cochlear-implants

Cochlear Implant Tutorial

Speech-language pathologists much know the basics of CIs when working with AI children. Although a CI does not “cure” hearing, it does allow for the perception of sound (Zwolan, 2015).

Who plays a role in the CI process? (*Cochlear Implants,* 2004)

The role of the CI team is to determine candidacy, educate patient and family on device options, provide medical care, and provide post-implant device programming, monitoring, and rehabilitation. CI team members pre- and post-surgery may include the surgeon (otolaryngologist), audiologist, SLP, psychologist, social worker, educational specialist, aural rehabilitation specialist, neuropsychologist, and vocational rehabilitation specialist. Prior to surgery, the focus of care is to determine medical and audiological suitability for CI implantation. Following surgery and post-implant healing, the focus shifts from medical management to audiological management and communication intervention.

Benefits from a CI depend on many factors, including some of the following:

- Age of the patient when he/she receives implant
- When AI was presented: before or after developing language skills
- Motivation of patient and family/support system

What are the Components of CIs? (“Audiology Information Series,” n.d.)

- **Microphone**: picks up sound and sends it to the speech processor
- **Speech processor:** allows the sound to be transduced to a digital signal, processed and delivered through the transmitter coil on the outside of the head across the scalp to the implant
- **Implant**: converts digital signal to electrical impulses which are conveyed to the electrode array
- **Electrodes**: stimulate neural fibers inside the cochlea and send an electrical signal to the brain, where it is interpreted as sound and decoded

What are some maintenance tips for my CI?

- Keep processor clean and free from moisture on the inside
- Every night, wipe outside, cable, and coil with a soft dry cloth to prevent dirt build up
- Take apart processor once a week and clean: blow on battery ports to remove dust
- Change microphone protectors regularly (every 2-3 months)

For more maintenance tips:
http://www.cochlear.com/wps/wcm/connect/in/home/support/cochlear-implant-systems/care-and-maintenance

FM System

A *frequency modulated* (FM) system is standard equipment for children with AI found in educational settings. The FM system provides a wireless connection to the child's amplification device such as their hearing aid. This system serves to improve the signal level and signal-to-noise (S/N) ratio in the listener's ear (Lewis & Murphy, 1999).

HOW DOES AN FM SYSTEM WORK?

A microphone is placed close to the sound source. The transmitter then uses the electrical signal from the microphone to modulate a designated frequency which is broadcast over a large area. The listener uses the FM receiver to pick up and demodulate the signal, which is then sent to the ear through a headset or a HA (Lewis & Murphy, 1999).

Table 4. Choosing FM Systems

Strengths	Weaknesses
Excellent sound quality	Can be expensive
Easy to use	Subject to FM interference
Used indoors and outdoors	Privacy not guaranteed
Receiver does not need to be in direct line with transmitter	No standard exists for the selection, evaluation, and fitting of FM systems
Several systems can be used in same area (using different carrier frequencies)	Acceptance of the device

Source: (Lewis & Murphy, 1999)

FM SOUND FIELD SYSTEMS

- May help improve signal to noise ratio (SNR) for improved audibility
- Especially beneficial for some children including:
    - Children with fluctuating AI due to otitis media
    - Children with ADD
    - Children with unilateral HL

WHERE ARE FM SYSTEMS USED?

In the Schools

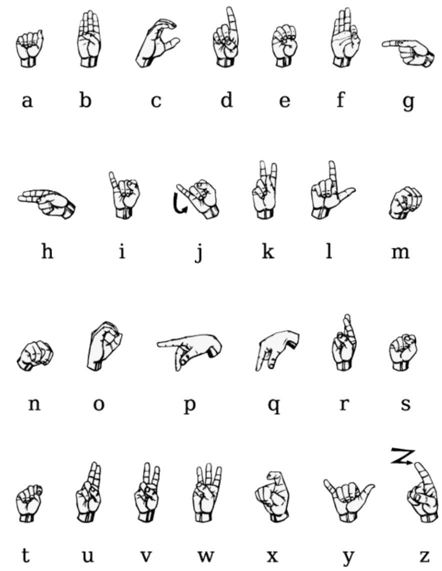
- Teacher wears a microphone: the microphone can be wired into a *small battery-powered transmitter* that is also worn or it can be wireless and send a signal to an AC-powered *transmitter*
- FM sound field amplification designed for *all* children (both AI and typical hearing) (Hull, 2010)
- Typical hearing kids who have disorders of articulation, auditory processing, attention, learning, and language

Public facilities

- Electrical signal from the public system is typically used as the input to the FM transmitter
- Auditorium, place of worship, train station theaters, museums, and other large areas for gathering

CHAPTER 2: COMMUNICATION OPTIONS

Figure 5. ASL



Source: http://www.clipartkid.com/american-sign-language-cliparts/

Annually, 10,000 children are born with SNHL and more than 95% of AI children are born to hearing parents in the U.S. One of the hardest decisions parents of these children make is the path of speech and language. While some parents may view AI as part of their own culture and choose sign language as their child's primary form of communication, other parents may perceive AI as a disability. Once a child is identified as AI, a parent must decide if an amplification device is desired and whether the child will communicate through sign language, spoken, or mixture (Tye-Murray, 2015).

Types of Communication

AMERICAN SIGN LANGUAGE (ASL)

ASL is a visual and manual mode of communication through configuration, orientation, location in space, and movement (Tye-Murray, 2015).

Components of ASL

- Signs (can represent words or concepts)
- Unique grammar structure (different from spoken English)
- Facial expressions
- Body movements

Early sign language prior to receiving an implant can support foundation for language learning such as enabling joint attention and parent-child communication. At the same time, any residual hearing should be maximized to accelerate rates of spoken language after implantation. Immediately after implantation, the focus of language should shift to enhancing acoustic properties of speech as much as possible to optimize the ability to talk and listen (Mellon, Niparko, Rathmann, Mathur, & Humphries, 2015).

Bilingual/bicultural children often learn their community sign system first and then learn English or another language later. Other countries' sign systems tend to vary significantly from one another, yet some systems may reflect influences from another country such as New Zealand sign language (NZSL) deriving from British Sign Language (BSL) (Mellon, 2015).

MANUALLY CODED ENGLISH OR SIGNED EXACT ENGLISH (SEE)

SEE refers to signs that correspond directly to English words and share the same syntactic structures of English. Individuals who manually code often will also speak simultaneously with each word (Tye-Murray, 2015).

TOTAL COMMUNICATION

Total communication refers to the use of every available mode of communication including sign, residual hearing, and lip/speech reading (Tye-Murray, 2015).

AURAL/ORAL LANGUAGE

Aural language is used by people with typical hearing to speak and listen to messages. Children with AI who use aural/oral language tend to rely on speaking and speechreading to receive messages.

- **Multisensory approach** utilizes both vision, residual hearing, and/or touch to recognize speech
- **Unisensory approach** solely utilizes residual hearing to receive spoken messages. This approach emphasizes the use of audition over vision to enhance communication development using amplification or electrical stimulation such as a CI (Tye-Murray, 2015).

SPEECH READING

Speech reading or "lip-reading" involves using visual cues to understand what the speaker is saying. The listener watches movements and shape of the lips, jaw, and tongue to decipher speech. Facial expressions, hand movements, and gestures are also utilized to understand a speaker's message. However, only 30% of sounds are visible on the face including /v/, /f/, /m/, /p/, and /b/ (Tye-Murray, 2004).

CUED SPEECH

Cued speech is a system that enhances speechreading with the combination of phonemically based hand gestures (Cornett, 1967). The combination of visual speech signal and the stream of hand signs distinguish words and messages. There are 8 different hand shapes to distinguish consonants and 6 locations on the face and neck to distinguish vowels. The variations of hands and facial positons create different words.

For more information on cued speech:
http://www.cuedspeech.org/cued-speech/international-cue-charts.php

CHAPTER 3: THERAPY APPROACHES

AUDITORY VERBAL THERAPY

Auditory-Verbal Therapy (AVT) for AI children relies on listening as the primary modality to increase spoken language development. AVT incorporates parent participation and the guidance of a Listening and Spoken Language Specialists (LSLS) to teach the AI child to listen and speak, and enhance educational, social and emotional integration with hearing peers (Lim et al., 2005). LSLS are licensed SLPs, audiologists, or educators ("Alexander Graham Bell Academy," n.d.). Therapy focuses on audition, speech, language, cognition, and communication involving play-based, everyday routines, and parent-child interaction. Children gradually learn to listen and identify different sounds from their own voice, the environment, and others around them (Chowdhry, 2010).

Components of LSLS-AVT Therapy ("Alexander Graham Bell Academy," n.d.)

- Promotes early diagnosis of AI followed by immediate audiologic management and therapy
- Teaches parents to help their child use hearing as the primary sensory mode to develop listening and spoken language
- Teaches parents how to be the primary facilitator of their child's language development
- Creates environments that support listening for acquisition of spoken language through daily activities
- Helps child self-monitor spoken language through listening

Example of AVT Listen & Talk Program

In this program, AI children are fitted with amplification and then begin AVT therapy. Parents are educated and guided through weekly sessions to learn to incorporate learned strategies into daily routines and interactions with their child. The goal is for parents and caregivers to develop the confidence and skills needed to implement therapy techniques at home and increase overall listening and spoken language (Lim et al., 2005).

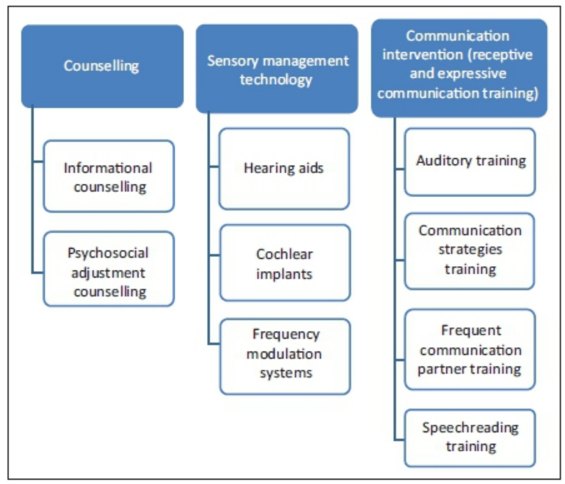
For more information on Listen & Talk Program:
https://www.sgh.com.sg/clinical-departments-centers/hearingandearimplant/pages/listen-talk-programme.aspx

Aural Rehabilitation

Aural rehabilitation (AR) includes services that help an individual minimize or overcome the challenges associated with AI, including communicative breakdowns or psychosocial consequences (Hull, 2010)

- Attempts to reduce the barriers to communication that result from AI and facilitate adjustment to the emotional, social, educational, and occupational impacts (Hull, 2010)

Figure 6. AR Components and Services



Source: Adapted from Prendergast, S.G., & Kelley, L.A. (2002). Aural rehabilitation services: Survey reports who offers which ones and how often. *The Hearing Journal, 55*(9), 30–34. http://dx.doi.org/10.1097/01.HJ.0000293926.87482.df

Examples of services

- Counseling
- Assessment of AI/communication deficits
- Selecting and fitting listening devices
- Communication, speechreading, and auditory training
- Speech, language, and literacy training
- Classroom and workplace management

Counseling Families

While many parents embrace an AI as part of their own culture, other parents may view AI as a terrible loss. Parents often experience "chronic grief," or daily reminders or events that remind a parent of what they have lost with a child of AI. Triggers may be in the form of a family gathering or birthday party, where parents compare their child to typically developing children (Luterman & Ed, 2001). While family or friends may try to make the parents of AI children feel better, these attempts instead unintentionally invalidate the parent's feelings, leading to further isolation and alienation. Instead, these parents often need to be listened to and have their feelings validated (Luterman & Ed, 2001).

5 Stages in the Grief Cycle (Kubler-Ross, 1969)

1. Denial
2. Anger
3. Bargaining
4. Depression
5. Acceptance

Aural rehabilitation counselling includes providing clients with information about hearing, effects of AI, importance of intervention, and the formulation of realistic expectations of intervention. Counselling may also be used to address issues of cultural and stereotypical beliefs affecting AI and rehabilitation (De Andrade & Ross, 2005; Mackenzie, 1999).

For more information on AR:
Alpiner, J. G., & McCarthy, P. A. (2000). *Rehabilitative audiology: Children and adults* (3rd ed.). Baltimore, MD: Lippincott Williams & Wilkins. Hawkins, D. B. (2005). Effectiveness of counseling-based adult group aural rehabilitation programs: A systematic review of the evidence. *Journal of the American Academy of Audiology, 16*, 485–493.

COMMUNICATION STRATEGIES

Self-efficacy is the belief that a person can be successful in performing a task, independent of external odds. In AR, self-efficacy refers to the belief that patients can manage difficult communication situations, and they can plan and execute a course of action that will improve their communication interactions in each environment (Tye-Murray, 2010). A patient's self-efficacy determines the willingness to engage and communicate with others when faced with challenging situations or environments.

Strategies for Enhancing Self-Efficacy (Tye-Murray, 2010)

- **Mastery experience:** practicing repair strategies several times in a safe and comfortable environment
- **Vicarious experience:** direct observation of other communication attempts
- **Verbal persuasion:** explaining to the patient that they have the tools to manage communication breakdowns
- **Emotional arousal:** relaxation or breathing techniques can enhance self-efficacy by lowering a person's arousal if a patient becomes nervous before attending a social event

Table 5. Examples of AI Speech Characteristics

Resonance	Articulation
• Hypernasal • Hyponasal • Abnormal pharyngeal resonance	• Vowel neutralization • Produce few consonants & develop them later in life • Produce more visible consonants (e.g. /p/) than at back of mouth (e.g. /k/) • Difficulty distinguishing voice and voiceless consonants • Omissions, distortions, substitutions

Auditory Training/Sensory Management typically begins with HAs or CIs to begin the intervention process. FM systems are also an effective treatment of peripheral hearing and processing difficulties (Sykes, 2010). While auditory training involves teaching strategies to effectively *listen* during conversation, communication training improves expressive communication or *output* (Tye-Murray, 2009).

Room Acoustics (Hull, 2010)

In a classroom, speech perception may be improved by:

- Decreasing distance between speaker and listening ("microphone-ear distance")
- Keeping the listening within critical distance, or the distance from the sound source at which sounds are of equivalent loudness levels (Rosenberg, 2010)
- Using a group of amplification systems (e.g. FM wireless, infrared)
- Improve acoustics in older buildings such as:
    - Line door frames with felt
    - Carpet rooms
    - Use of curtains
    - Incorporate felt or rubber stoppers on bottoms of chairs and desks
    - Use of FM systems

GLOBAL CHALLENGES

Many countries, such as South Africa, lack resources (e.g. time, tools, and audiology staff) to provide effective services (Swanepoel et al., 2010). Many audiologists do not even provide AR because of the lack of adequate reimbursement for these services, and thus have little interest in AR. Another challenge is socioeconomic factors that play a role in service delivery such as unaffordability of transport costs and client compliance.

CHAPTER 4: TREATMENT

BACKGROUND INFORMATION

AI may encompass the following: Deafness, hard of hearing, hearing impairment, hearing loss, or deaf-blindness. About 391,000 school-aged children in the U.S. have unilateral HL and only 12% of the AI population have HAs (Archer & Crosby-Quinatoa, n.d.) Understanding the unique characteristics about this population is crucial for successful treatment and outcomes. Although there is limited research available for this population, treatment mainly targets speech and language development, with additional factors such as auditory training, counseling, and parent education. Important factors that affect communication for this population includes age of onset, degree/type, concomitant disorders, bilateral/unilateral involvement, family support, services available, and modes of communication.

INTERDISCIPLINARY TEAM APPROACH

An interdisciplinary team approach to treatment consists of uniting a number of different disciplines or professionals together in order to provide services in a coordinated way (Paul, 2010). For a child with AI, the core members of this team may include any of the following: an audiologist, SLP, school teacher, ENT or other physician, development specialist, AVT specialist, social worker, psychologist, and family members. Ultimately, this approach aims to integrate all individual components into one team. Professionals are also encouraged to question, challenge, and learn from their team members to effectively manage all aspects of the child's needs.

Treatment Considerations

THE LING SIX-SOUND TEST

Checking the function of the child's amplification system is essential for optimal hearing at all times. The Ling Six-Sound Test (Ling, 2002) is a quick and accurate assessment of a child's ability to hearing various frequencies needed for spoken language development. The test can be administered by the parent or clinician who produces the six sounds /m/, /ah/, /oo/, /ee/, /s/, and /sh/ one at a time in a random order, while recording the child's responses one ear at a time. The sounds represent frequencies across the speech spectrum from low to high pitch and allow the clinician to verify the device is working accurately (Moeller et al, 2016).

Hierarchy of Listening Skills (Archer & Crosby-Quinatoa, n.d.)

- **Detection**: respond to presence or absence of sounds
- **Discrimination**: distinguish differences and similarities between sounds
- **Identification**: label by repeating, pointing to, or writing speech sounds heard
- **Comprehension**: understand meaning of speech by following directions, answering questions, or engaging in conversation

Table 6. Normal Progression of Auditory Skills (Hull, 2010)

Age	Skills
0-3 months	Startles, quieted by mother, enjoys music or other auditory stimulation, listens to own vocalizations
3-6 months	Localization emerging, vocalizations to music
6-9 months	Good localization skills, responsive to own name, attentive to conversations
9-12 months	Begins to discriminate words

Facilitating Auditory Skills (Archer & Crosby-Quinatoa, n.d.)

- Use verbal cues to get attention
- Be aware of environmental sounds
- Encourage child to ask questions
- Begin with common phrases

Some Examples of Classroom Modifications (Archer & Crosby-Quinatoa, n.d.)

- Reduce noise
- Decrease distance between child and speaker
- Some reverberation is good, but too much is bad
- Personal FM systems (e.g. teacher wears microphone and FM transmitter)
- Sound field FM system (e.g. FM receiver connected to loudspeakers)
- Improve classroom acoustics (e.g. close door, cover windows with curtains)

Key Language Skills (Archer & Crosby-Quinatoa, n.d.)

- **Form**: ability to use correct grammatical form (e.g. subject-verb-object)
- **Content:** ability to understand and use vocabulary and concepts to get message across
- **Use**: ability to use language in variety of ways (e.g. conversation, body language, facial expression, turn taking)

Takeaways

Treating children with AI poses distinctive challenges. However, understanding these differences, as well as working alongside paraprofessionals, are important for successful outcomes. Some important considerations that can affect speech and language for this population include checking the function of the child's amplification system, incorporating language and listening, and facilitating auditory skills in all types of environments.

Therapy Material

The limited research in speech and language therapy for children with AI makes it difficult to determine one specific therapy method that yields the best outcomes for this population. Treatment does, however, follow similar techniques used in traditional speech and language therapy, with additional factors that solely serve the AI population. For example, because many children with AI present with speech and/or language disorders, therapy may focus on morphology, articulation, syntax, morphosyntax, and grammar, while also addressing hearing specific features such as auditory training/discrimination and parent education on AI. Some examples of activities that may be utilized in speech therapy for children with AI include:

BASIC LISTENING ACTIVITIES

Activity #1

1. Give the child a plastic car.
2. Instruct the child to move the car as he/she hears the noise. When the noise begins, the car moves. When the noise stops, the car stops.
3. Make a noise for the child to respond to using both audio and visual cues, and repeat three times.
4. Use an auditory hoop and make the noise for the child again, to work on audio only detection.
5. Praise the child for correct responses.

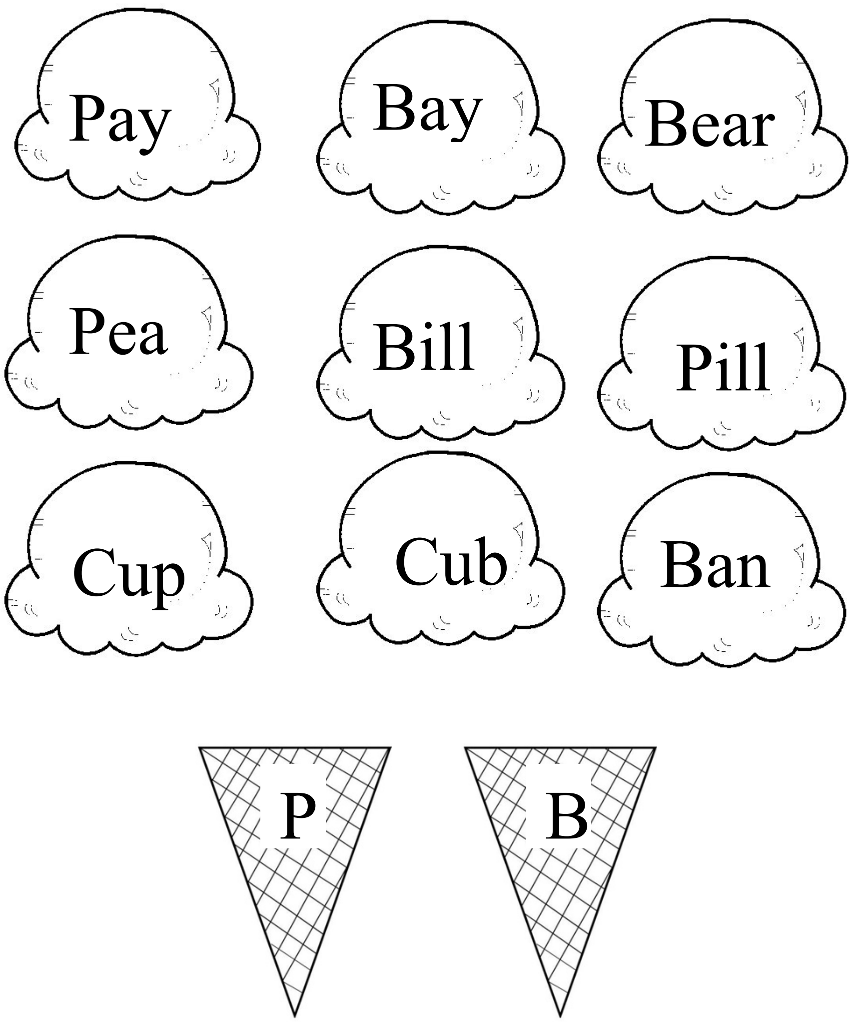
Activity #2

1. Listen to different environmental sounds paired with visual model of the word
2. Have the child listen again and identify each sound without visual model

For more information on basic listening activities:
http://krbo23.tripod.com/ar/page10.html
https://www.youtube.com/watch?v=HvV-SxflmyY

AUDITORY DISCRIMINATION TASK

Cut out different ice cream tops. Clinician will then mix up minimal pairs for target sounds (e.g. /p/ and /b/). Clinician will cover mouth and have client distinguish which word she is saying. Client will place correct word on correct ice cream cone only if client correctly distinguishes sound on the first try. Clinician may need to adjust visual cues (e.g. start with lip reading and eventually aim for pure auditory discrimination).



For more information on Auditory Discrimination:
http://www.journals.uchicago.edu/doi/abs/10.1086/459824?journalCode=esj

Grammar

With a partner, fill in the blanks of various Mad Libs. Your partner will tell you what kind of word you need to say. For example, if your partner tells you to say and *adjective*, think of a describing word such as big, tiny, red, smelly, shiny, yummy, slippery, fast, or any other description word. When you are finished filling in the blanks, read the story you have created! Usually the stories end up being very silly!

SUMMER VACATION

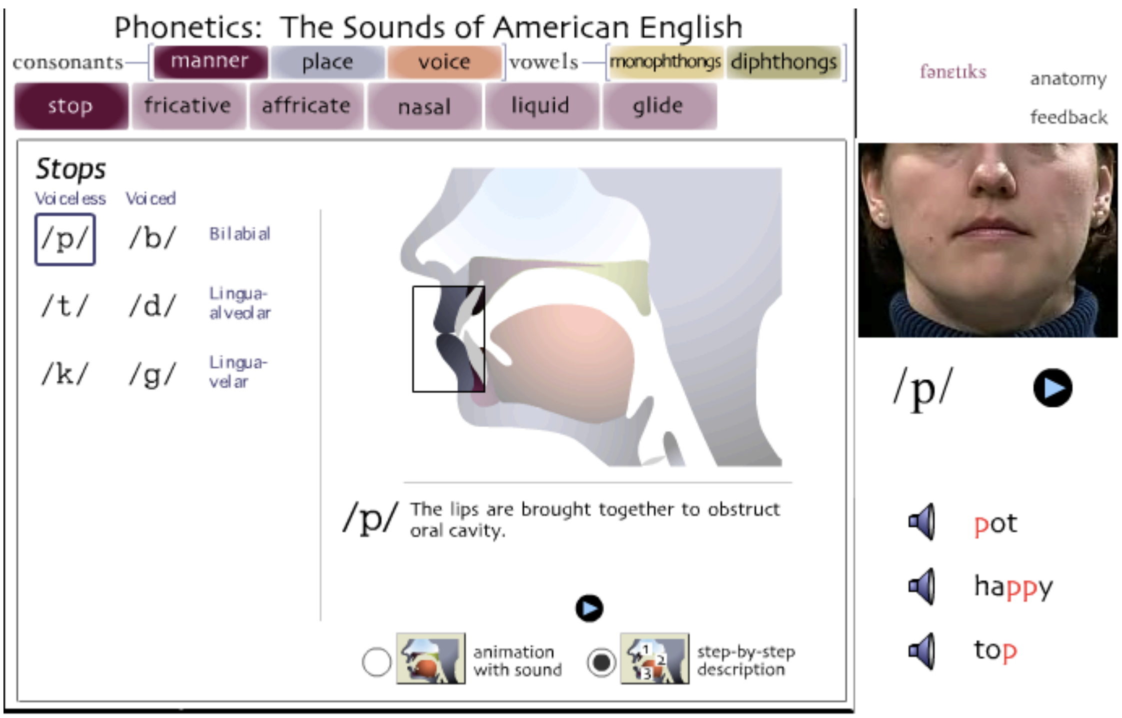
Last July, my family went to ____(noun)___, and brought lots of ____(noun)____. It was a very ___(adjective)____ week with my ____(number)___ cousins, friends, aunts, and uncles. We got to ___(verb)___ together at the beach all day and even got to ___(verb)___ after dinner. It was an amazing week and my parents even bought me a ___(noun)_! I can't want to go on another ___(noun)___ one day!

TACTILE APPROACH FOR ARTICULATION

If the child has difficulty finding the right spot in their mouth to place their tongue for certain sounds, tactile tools can help the child identify the position of their tongue. With parental consent, clinicians can put a dab of peanut butter or use a small lollipop to tap the place of articulation in the mouth. For example, if the child has trouble identifying the /t/ or /d/ sound because of their AI, place the candy directly behind their top teeth along the alveolar ridge and ask the child to touch it with the tip of their tongue. This will train the tongue to identify the correct position for specific sounds.

VISUAL MODELING

Use tutorials for place and manner of articulation from the University of Iowa website. This tutorial gives a visual and verbal explanation of different sounds in an anatomical model and through videos. This is a great resource for both kids and parents to see exactly the placement of the tongue when learning new sounds.



Source: http://soundsofspeech.uiowa.edu/english/english.html

Parent Training

PRACTICING AT HOME

- Practice correct pronunciation of words that have the s, b, p, d, t, g, and k sounds.
    - The **s** sound is made with the tongue just behind the front teeth. The lips are spread and you make a hissing sound like a snake.
    - The **b** sound is made by blowing the lips apart. The vocal folds vibrate.
    - The **p** is also made by blowing the lips apart but the vocal folds do not vibrate.
    - The **d** sound is made with the tongue going up to touch the bump just behind the front teeth and then coming down. The vocal folds vibrate.
    - The **t** sound is made the same as the d but the vocal folds do not vibrate.
    - The **g** sound is made in the back of the mouth. The tongue goes up in the back and then comes down. The vocal folds vibrate.
    - The **k** sound is made the same as the g but the vocal folds do not vibrate. This sound is made almost like you are coughing.
- Read! The more you read the better.
    - When reading, go over words that are difficult or words that you do not understand.
- Talk about the names of things in everyday life. While your child may know a lot of words, he or she may not know some of the more specific (e.g. faucet instead of sink)
    - By simply talking about things in the environment and encouraging your child to ask questions, their vocabulary will grow.
- Practice having your child use complete sentences, such as **Subject-Verb-Object**. (Kaiser & Hancock, 2003)
- Spend some time practicing using **listening only**. For example, you can have pictures spread out and have her listen (without lip-reading) to you saying the name of a picture. She must point to the object you named.

For more information on Parent Training:

http://www.asha.org/PRPSpecificTopic.aspx?folderid=8589935321&section=Treatment

http://soundsofspeech.uiowa.edu/english/english.html

http://www.asha.org/uploadedFiles/AIS-Improving-Listening-Experience.pdf

Case Study

BACKGROUND INFORMATION

Annie is a 5-year-old female client who lives with her parents in Austin, Texas. She was first diagnosed with severe to profound bilateral SNHL at the age of 2 years. As an infant, she had several ear infections and was exposed to ototoxic medications. Annie currently uses primarily 2-3 word utterances and does not use any signs to communicate, but heavily relies on lip reading as a form of communication. She uses English at home and at school. She was evaluated at the University of Texas Speech and Hearing Clinic (UTSHC) in February of 2016 with subsequent diagnosis of speech and language development delay due to AI. She was fit with her first set of HAs and began receiving speech therapy at the UTSHC in March 2016.

SPEECH ASSESSMENT

To assess Annie's speech and language skills, the follow measures were administered: CDI, EOWPVT-4, ROWPVT-4, CELF-5, and a language sample. Clinicians also interviewed Annie's parents to get basic medical history and any relevant information. Then, Annie was assessed informally on (1) Basic listening, (2) vocabulary, and (3) grammar skills.

Examples:

(1) Clinicians placed various objects around therapy room and covered their mouths (to avoid lip reading). As the clinician named each object, client would listen and select correct item.

(2) Client would name various school-related vocabulary items found in a reading book.

(3) Clinicians introduced Subject + Verb sentence structure and made simple sentences using objects and picture cards, along with written cues (e.g. The boy laughs). Client would then create her own sentences with this grammatical structure.

COMMUNICATION PROFILE

Annie's speech skills were found to be delayed in terms of how accurately she produces consonants due high frequency HL. Client has difficulty producing nasal /m, n/ and voiceless stops /p, t, k/ and fricative /s/ in all word positions. For her age range, she also has a very limited vocabulary, grammar, and a low MLU of 2.0. Annie has both low receptive and expressive language due to her HL without any amplification for several years.

CLIENT INTERVENTION

Treatment targets AR to increase overall speech, language, and hearing skills. Clinicians model and use multiple repetitions of correct productions of phonemes, use auditory discrimination activities to distinguish lexically similar sounds (e.g. minimal pairs), and use visual articulation cues. Clinicians introduce new vocabulary through readings, labeling novel objects, instruction of definitions of words, as well as using synonyms/antonyms for vocabulary words. Activities for subject-verb-object (SVO) grammar include reading activities, modeling SVO sentences, identifying parts of speech, and practicing constructing SVO sentences both verbally and in writing. Increased length of utterance is targeted through extension and expansion. Specific activities focus on increasing auditory skills and using solely audition instead of relying on visual (e.g. written, picture, lip reading) cues. Approaches include sound discrimination, word knowledge, concepts, rules of grammar, and use of compensatory skills to increase overall speech, language, and hearing abilities (ASHA, 2016).

Table 7. Examples of Therapy Goals

Long-Term Outcome (LTO 1): Client will increase overall receptive speech and language abilities.	**Short-Term Outcome (STO 1):** Client will discriminate between words that vary by one characteristic (place, manner, voicing) including voiceless stops /t, k, p/ and bilabial /m, n/ sounds.
LTO 2: Client will increase overall expressive speech and language abilities both receptively and expressively.	**STO 2:** Client will use Subject-Verb-Object syntax pattern in her sentences with 80% accuracy over 10 utterances with minimal cueing.

PARENT TRAINING

After parents learn new intervention strategies and generalized their newly trained skills to interactions at home, children showed generalization and maintenance of newly learned language skills when observed at home (Kaiser & Hancock, 2003). Clinicians educate and send home material with parents weekly. Initially, clinicians provide parents with basic information on how AI impacts speech and language (e.g. explain speech banana). Afterwards, clinicians sent home similar practice material from therapy sessions that focused the goals targeted each week. Clinicians included one long term and one short term goal for parent training and at home practice for Annie's parents.

Table 8. Examples of Parent Goals

LTO 3: Caregiver will model speech and language and encourage client's skills at home.	**STO 3**: Caregiver will engage in activities at home to help the client discriminate and produce bilabial stops, increase her vocabulary, use Subject-Verb-Object sentence structure, increase her length of utterance, and decrease reliance on visual cues.

OUTCOMES

After only 3 months of therapy, Annie became accustomed to her new hearing aids, increased MLU from 2.0 to 4.0, increased SVO use in sentences from 50% to 80%, and increased production of /p, t, k, s/ in all word positions from 49% to 60%. Although Annie currently still needs maximum to moderate cueing, she has become less reliant on lip reading and accuracy of articulatory positions for these sounds. Annie continues need to work on auditory discrimination and expressive language skills for many sounds such voiced versus voiceless sounds (e.g. /b/ versus /p/).

For More Information on Parent Training:
http://www.asha.org/EvidenceMapLanding.aspx?id=8589937572&recentarticles=false&year=undefined&tab=all

Example Lesson Plan

Table 9. Lesson Plan

Therapy Goals	Procedures
STO 1: Client will be introduced to 5 novel vocabulary words each week in structured activities and use them appropriately in sentences with 80% accuracy and minimal cueing.	Use articulation cards to find 5 new words and sounds that client is practicing such as /p, b, t, d, k, g/ Use **Core Vocabulary Approach**
STO 2: Client will produce /t, k, p, s, b/ in all word positions throughout structured activities with 80% accuracy using moderate assistance of visual and or/written aids.	Review /p, b, k, g/ and have client feel throat (vibration when speaking) Introduce new sounds: /t/ and /d/ sounds at initial, medial, and final position -Use candy for **tactile approach** -Use **articulation cards** for visual model
STO 3: Client will discriminate between words that vary by one characteristic (place, manner, voicing) including voiceless stops /t, k, p/ and bilabial /m, n/ sounds.	Discrimination game between /p/ and /b/ Clinician will say /p/ or /b/ words on visual models and the client will decide what sound she heard (**Auditory Discrimination Task)**
STO 4: Client will use Subject-Verb-Object syntax pattern in her sentences with 80% accuracy over 10 utterances with minimal cueing.	Clinician will provide client with mad libs and client will come up with different parts of speech Then, client will go through the passage and circle the subject, verb, and objects
Parent Training: Caregiver will model speech and language and encourage client's skills at home	Clinician will discuss client progress with caregiver and provide worksheets to practice articulation and production/discrimination of /p, b, t, d, k, g/

For More Information On:

Core Vocabulary: http://www-tandfonline-com.ezproxy.lib.utexas.edu/doi/full/10.3109/02699206.2014.926994

https://www.med.unc.edu/ahs/clds/files/conference-hand-outs/ASHACoreVocabulary2014HO.pdf

Auditory Discrimination: http://www.journals.uchicago.edu/doi/abs/10.1086/459824?journalCode=esj

WHAT SHOULD MY CHILD BE ABLE TO DO?

Hearing and Understanding	**Talking**
Birth–3 Months • Startles to loud sounds • Quiets or smiles when spoken to • Seems to recognize your voice and quiets if crying	**Birth–3 Months** • Makes pleasure sounds (cooing, gooing) • Cries differently for different needs • Smiles when sees you
4–6 Months • Moves eyes in direction of sounds • Responds to changes in tone of your voice • Notices toys that make sounds • Pays attention to music	**4–6 Months** • Babbling sounds more speech-like with many different sounds, including *p, b* and *m* • Chuckles and laughs • Vocalizes excitement and displeasure
7 Months–1 Year • Enjoys games like peek-a-boo and pat-a-cake • Turns and looks in direction of sounds • Listens when spoken to • Recognizes words for common items like "cup", "shoe", "book", or "juice"	**7 Months–1 Year** • Babbling has both long and short groups of sounds such as "tata upup bibibibi" • Uses speech or noncrying sounds to get and keep attention • Imitates different speech sounds

Source: http://www.asha.org/public/speech/development/chart/

Appendices

APPENDIX A: OTHER RELEVANT TERMS

Anotia	Complete absence of external ear and ear canal
Assisted listening Device (ALD)	Non-hearing aid device used to improve communication and performance of activities in specific environments (e.g. personal FM systems, closed captioning)
Atresia	Congenital closure of the external auditory canal
Audiometer	Equipment to asses hearing threshold and speech awareness
Auditory brainstem response (ABR)	May also be referred to as auditory evoked potential (AEP). This test is performed by passing electrodes on the head and recording brain wave activity in response to sound.
Cerumen	Ear wax
Cochlear pathology	Nerve damage in cochlear, sensory receptors within the cochlea are destroyed
Disequilibrium	Disturbance of balance
Encephalitis	Inflammation of the brain
Exostosis	Bony growth in ear canal
Feedback	High-pitched whistling sound that can be emitted by a hearing aid when the microphone picks up its own output
Fistula	Abnormal hole or rupture between the middle ear cavity and cochlea
Gain	The amount of additional intensity added by an amplifier
Impedance	Object or medium's resistance to energy flow
Meniere's Disease	Inner ear disorder that can affect hearing and balance, often associated with vertigo, AI, tinnitus, and sensation of "fullness" in the ear
Meningitis	Common cause of SNHL caused by bacterial or viral inflammation of the meninges. The meninges are the membranous linings of the brain and spinal cord
Microtia	Congenitally small external ear
Otitis Media	Inflammation of the middle ear, often accompanied by accumulation of fluid in the middle ear cavity
Otitis Media	Inflammation of the middle ear caused by infection
Otosclerosis	Abnormal growth of bone around ossicles and inner ear
Ototoxic Drugs	Harmful to structures of the inner ear and auditory nerves
Retrocochlear HL	AI beyond the cochlea (inner ear) either along the auditory nerve, areas of the brain that process speech, or other areas of the central auditory system

Appendix B: Pamphlet for SLPs

Considerations for Children with AI

- Speech & Language
  http://www.asha.org/PRPSpecificTopic.aspx?folderid=8589935321&section=Treatment

  https://www.teacherspayteachers.com/Browse/PreK-12-Subject-Area/Speech-Therapy/Price-Range/Free

  http://soundsofspeech.uiowa.edu/english/english.html
- Hearing
  http://www.asha.org/uploadedFiles/AIS-Improving-Listening-Experience.pdf

  https://www.agbell.org/SpeechBanana/
- Developmental Communication Skills
  http://www.asha.org/public/speech/development/chart/

Who We Are

About Us

Information found in this pamphlet is a compilation of various resources from textbooks, online sites, and programs. In depth analysis can be found in the master's report, written by Liana Martinez, graduate clinician, supervised by clinical faculty, Dr. Madhu Sundarrajan. If you have any questions, please feel free to contact us at any time.

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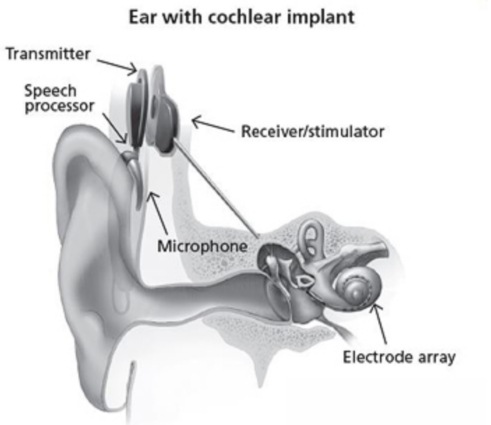
SPEECH, LANGUAGE, & HEARING RESOURCES

Fundamentals of Auditory Impairment for the Speech-Language Pathologist



How Do I Help My Client?

What should SLPs know about the AI population?

The purpose of this guide is to outline resources for speech, language, and hearing that are needed for speech-language pathologists (SLPs) to work with children with auditory impairment (AI). Specifically, SLPs must understand the basics of audiology and aural rehabilitation when working with this population and the impact hearing problems have on speech and language.

Areas of Treatment

Treatment mainly targets speech and language development, with additional factors such as auditory training, counseling, and parent education. Important factors that affect communication for this population includes age of onset, degree/type, concomitant disorders, bilateral/unilateral involvement, family support, services available, and modes of communication.

- Auditory Discrimination Tasks
- Grammar
- Visual Modeling & Tactile Cues

"Annually, 10,000 children are born with sensorineural hearing loss and more than 95% of deaf children are born to hearing parents in the U.S." - Tye-Murray (2015)

What Do SLPs Need To Know About Amplification Devices?

Hearing Aids
http://www.asha.org/uploadedFiles/AIS-Learning-Hearing-Aids.pdf

Cochlear Implants
http://www.asha.org/uploadedFiles/AIS-Cochlear-Implants.pdf

FM Systems
Lewis, D., & Murphy, B. R. (1999). Guidelines for Fitting and Monitoring FM Systems, 151–171.

Child with Hearing Aids

Communication Options

Once a child is identified as profoundly deaf or hard of hearing, a parent must decide if a cochlear implant is desired and/or whether the child will communicate through sign language, spoken, or mixture. (Tye-Murray, 2015).

- **American Sign Language**
- **Manually Coded English**
- **Total Communication**
- **Aural Rehabilitation**
- **Cued Speech**

http://www.cuedspeech.org/cued-speech/international-cue-charts.php

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